REMARKS

Applicants have amended their claims in order further clarify the definition of various aspects of the present invention. Specifically, claims 1 and 4 have been amended to further clarify that the specific surface area of the silver particle contained in the conductor paste is a specific surface area in the conductor paste prior to firing. In addition, independent claim 2 has been amended to incorporate therein how the conductor film is formed, consistent with recitations in connection therewith in currently amended claim 1.

In addition, Applicants are adding new claims 7-9 to the application. Claims 7-9, dependent respectively on claims 1, 2 and 4, recite that the glass of the ceramic board is a borosilicate glass. Note, for example, the last full paragraph on page 4 of Applicants' specification.

Applicants respectfully submit that all of the claims being considered on the merits in the present application patentably distinguish over the teachings of the references applied by the Examiner in rejecting claims in the Office Action mailed December 3, 2003, that is, the teachings of the U.S. Patents to Kodera, et al., No. 6,338,893, to Kawakita, et al., No. 5,652,042, and to Jeng-Shyong, et al., No. 5,292,359, under the provisions of 35 USC §103.

It is respectfully submitted that these references as applied by the Examiner would have neither taught nor would have suggested such an electronic component as in the present claims, including, inter alia, wherein the conductor film is formed using a conductor paste which does not contain any glass and which contains a silver particle having a specific surface area of $0.3m^2/g$ to $3.0m^2/g$ prior to firing, and, moreover, wherein the firing of the conductor paste, for forming the conductor film, has been

performed at a temperature having a difference of ±50°C from a softening temperature of the glass of the ceramic board. See claims 1 and 2; note also claim 4.

In addition, it is respectively submitted that the teachings of the applied references would have neither disclosed nor would have suggested such electronic component, having features as discussed previously in connection with claims 1, 2 and 4, and, additionally, wherein the glass intrudes into the conductor film from a surface on the ceramic board side and is not exposed on a surface of the opposite side of the ceramic board. See claim 2.

Furthermore, it is respectfully submitted that the teachings of the applied references would have neither disclosed nor would have suggested such electronic component as in the present claims, having features as discussed previously in connection with claims 1, 2 and 4, and, furthermore, having additional features including (but not limited to) wherein the conductor paste includes, in addition to silver, at least one selected from the group consisting of platinum and palladium (see claim 5), with the at least one selected from the group consisting of platinum and palladium being included in the conductor paste in an amount sufficient to prevent silver migration and solder leaching (see claim 6); and/or wherein the glass of the (glass) ceramic board is a borosilicate glass (see claims 7-9).

Moreover, even assuming, arguendo, that the teachings of the applied references would have established a prima facie case of obviousness, the evidence in the original disclosure of the above-identified application establishes unexpectedly better results achieved in solder wettability to the conductor film, and bonding strength of the conductor film to the (glass) ceramic board, using the conductor paste containing silver particles having the specified surface area and wherein the firing has been

performed at a temperature relative to softening temperature of the glass of the (glass) ceramic board as in the present claims; and in view thereof clearly establishes patentability of the presently claimed invention. That is, it is respectfully submitted that even if the references establish a prima facie case of obviousness, the evidence of record (in the original disclosure of the above-identified application) clearly rebuts any such prima facie case, and establishes unobviousness of the presently claimed subject matter. In this regard, it is respectfully submitted that the evidence of record in the above-identified application (in the original disclosure) must be considered in determining patentability of the present invention. See In re DeBlauwe, 222 USPQ 191 (CAFC 1984).

In prior responses filed in the above-identified application (see pages 4-6 of the Amendment filed February 14, 2003, and pages 2-5 of the Response filed September 22, 2003), Applicants have repeatedly requested that the Examiner consider the evidence of record in the above-identified application, that is, the data in Applicants' original disclosure. That the Examiner must comment on this evidence is required in Manual of Patent Examining Procedure 716.01(a) (Examiner must consider comparative data in the specification which is intended to illustrate the claimed invention in reaching a conclusion with regard to the obviousness of the claims). See also Manual of Patent Examining Procedure 716.01, stating that all entered affidavits, declarations, and other evidence traversing rejections are acknowledged and commented upon by the Examiner in the next succeeding action. Thus, the Examiner has failed to follow the guidelines of the Manual of Patent Examining Procedure. If the present rejection or any obviousness rejection is maintained by the Examiner, it is respectfully requested that the Examiner specifically comment on the evidence in

Applicants' specification being relied on by Applicants, as discussed further infra. In any event, it is respectfully submitted that the evidence in the specification of the above-identified application, of course being of record therein, must considered in determining patentability of the present invention. See In re DeBlauwe, supra.

The present invention is directed to an electronic component having a glass ceramic board with a silver-based conductor pattern on the surface thereof; and, in particular, is directed to providing such glass ceramic board with conductor film thereon, wherein solder wettability to the conductor film and a bonding strength of the conductor film to the glass ceramic board are good, and a bond of a gold wire with the conductor film is reliable.

As described in the paragraph bridging pages 1 and 2 of Applicants' specification, where the conductor pattern on the surface of a low temperature co-fired ceramic multilayer printed circuit board is formed of a silver-based conductor, it is difficult to provide good solder wettability and good bonding strength to the board, while providing a reliable bond with a gold wire. Applicants have found that by utilizing a conductor paste containing silver particles having a specific surface area of $0.3m^2/g$ to $3.0m^2/g$ prior to firing, as the paste for forming the silver-based conductor film, and by firing such paste at a temperature having a difference within 50°C (either greater than or less than) of the softening temperature of glass of the glass ceramic board, the goals of good solder wettability, good bonding strength of the conductor film to the board and reliable bonding with a gold wire are achieved.

That is, as seen in Fig. 2 of Applicants' disclosure, and described in the paragraph bridging pages 9 and 10 of Applicants' specification, the present inventors have found that solder wettability changes in accordance with 1) the temperature

difference between the firing temperature and the softening temperature of the borosilicate in the ceramic board, and 2) the particle size of silver particles in the conductor paste prior to firing. Specifically, it was found out that, when a specific surface area of the silver particle is $0.3m^2/g$ or more, the silver-based conductor film whose ratio of solder diameters after reflow relative to that before reflow, as a percentage, is 95% or more, can be formed by firing with a firing temperature which is different from the softening temperature of the borosilicate glass by 50°C or less.

Furthermore, as seen in Fig. 3 and the corresponding description in the paragraphs bridging pages 10 and 11, and pages 11 and 12, of Applicants' specification, the present inventors have found by experiments that a tensile strength changes in accordance with the specific surface area of the silver particle in the conductor paste prior to firing. If the specific surface area of the silver particle is more than $5m^2/g$, the tensile strength between the ceramic board and a bonding pad formed from the conductor paste is insufficient. Moreover, if the specific surface area of the silver particle prior to the firing is from $0.3m^2/g$ to $3.0m^2/g$, sufficient tensile strength between the ceramic board and the pad is achieved by firing at the firing temperature which is different from the softening temperature of the borosilicate glass by 50°C or less.

Thus, by utilizing a conductor film formed by firing at the temperature as set forth in the present claims, and by utilizing a conductor film formed from conductor paste with silver particles having the specific surface area (prior to the firing) as in the present claims, the objectives according to the present invention are achieved. Particularly in view of these objectives unexpectedly achieved according to the present invention,

clearly the presently claimed subject matter patentably distinguishes over the teachings of the applied prior art.

Again, Applicants refer to the evidence in their original disclosure (e.g., Figs. 2 and 3, and the corresponding description on pages 9-12 of Applicants' specification) for establishing unexpectedly better results, and therefore unobviousness, of the presently claimed subject matter. It is again emphasized that the Examiner has not previously commented on this evidence, notwithstanding reliance by Applicants on this evidence in the Amendment filed February 14, 2003, and in the Response filed September 22, 2003, in the above-identified application. It is respectfully submitted that this evidence, seen in Figs. 2 and 3 of Applicants original disclosure, together with the description in connection therewith on pages 9-12 of Applicants' specification, clearly shows the unexpectedly better results, and, correspondingly, unobviousness, of the presently claimed subject matter.

It is respectfully submitted that this evidence of unobviousness in Applicants' original disclosure shows unexpectedly better results achieved as compared with subject matter even closer to the present invention than that of the closest prior art, and clearly establishes unobviousness of the presently claimed subject matter. See Manual of Patent Examining Procedure 716.02(e).

Kodera, et al. discloses a conductive paste used for a ceramic printed circuit substrate formed of a glass ceramic, and a ceramic printed circuit substrate that uses this conductive paste. The conductive paste includes specific amounts of silver-platinum; manganese dioxide; copper oxide; silicon dioxide having a specific surface area of not less than $50m^2/g$ as measured by a BET method, an average primary grain size of 5-50nm and a purity not lower than 99.8%; and molybdenum and tungsten

powder. See column 4, lines 6-14. Note also column 4, lines 15-35, describing advantages of use of the manganese dioxide, silicon dioxide powder, copper oxide, molybdenum and tungsten powder, and absence of glass frit. This patent discloses that the ceramic printed circuit substrate includes an insulation portion formed of glass ceramic containing lead borosilicate glass as a glass component and a circuit portion containing silver as the main component, with at least part of the circuit portion being formed by use of the above-described conductive paste. This patent discloses that simultaneous firing is performed to form the ceramic printed circuit substrate and circuit conductor. See column 4, line 66 to column 5, line 37.

It is noted that Kodera, et al. discloses, primarily, use of a conductive paste including specified components, the components including, inter alia, silicon dioxide powder. It is respectfully submitted that this reference does not disclose, nor would have suggested, a conductor film formed by firing the conductor paste including silver particles having specific surface area prior to the firing, and temperature at which the conductor paste is fired, and advantages achieved thereby, as discussed in the foregoing.

The Examiner has relied on simultaneous firing in Kodera, et al., of the conductive paste and of the ceramic green sheet "at a temperature not higher than 1000°C.", as a basis for holding obvious the firing temperature of the conductor paste as in the present claims. This reliance for the conclusion of obviousness is respectfully traversed. It is respectfully submitted that this firing temperature not higher than 1000°C would not have disclosed, nor would have suggested, the conductor film having been formed by firing a conductor paste at a temperature having a difference of $\pm$50°C from a softening temperature of the glass of the glass ceramic board, much less this

firing temperature with the particle size, prior to the firing, of the silver particles of the conductor paste, much less the unexpectedly better results achieved thereby, as in the present invention.

It is respectfully submitted that the secondary references applied by the Examiner, Kawakita, et al. and Jeng-Shyong, et al., would not have rectified the deficiencies of Kodera, et al., such that the presently claimed invention as a whole would have been obvious to one of ordinary skill in the art.

Kawakita, et al. discloses a conductive paste compound used for filling via holes, which includes (a) a conductive filler in an amount of 80 to 92 weight percent, having an average particle size of 0.5 to 20μm and a specific surface area of 0.1 to 1.5 m^2/g, (b) a liquid epoxy resin in an amount of 4.5 to 20 weight percent, containing two or more epoxy groups and having a room temperature viscosity of 15 Pa·sec or less, and (c) a hardener at 0.5 to 5 weight percent, with the viscosity of the conductive paste compound being 2000 Pa·sec or less and the amount of volatile components being 2.0 weight percent or less. This patent goes on to disclose that it is preferable that the conductive filler includes at least one fine grain selected from the group consisting of gold, silver, palladium, copper, tin and lead, and that it is preferable that the fine grain has a diameter of from 0.5 to 20 μm. See col. 2, lines 15-35. This patent describes that the conductive filler should be provided with a specific surface area as small as possible in order to disperse the conductive filler with high concentration, a preferred surface area being from 0.1 to 1.0 m^2/g. See column 4, lines 59-64.

As can be seen from the foregoing, as well as from a full review of Kawakita, et al., this reference discloses a conductive paste compound for via hole filling, with the conductive filler having the described specific surface area to disperse the conductive

filler with high concentration. It is respectively submitted that one of ordinary skill in the art concerned with in Kodera, et al., for providing a conductive paste for a glass ceramic substrate, would not have looked to the via hole filling paste of Kawakita, et al.

In this regard, it is respectfully submitted that the metal powder of the via-hole-filling paste of Kawakita, et al. would not be sintered in use; and particularly in view of the differences between the material, function and procedures in connection with the via-hole-filling conductive paste in Kawakita, et al., and the ceramic printed circuit substrate as in Kodera, et al., one of ordinary skill in the art would not have looked to the teachings of Kawakita, et al., or would have utilized a conductive filler as in Kawakita, et al., with particle size as in Kawakita, et al. (for good dispersibility at high concentration as described in Kawakita, et al.), in the conductive paste of Kodera, et al.

Jeng-Shyong, et al., discloses a process for preparing silver-palladium powders that can be used for the production of electrode materials, contacts or the like used in the electronic industries, this patent describing that as a background thereof silver-palladium pastes have been widely used in thick film conductive circuits employed in screen printing (palladium being added to raise the melting point of silver and repress migration from occurring). The processes for preparing silver-palladium powders is described most generally at column 1, lines 54-61, and includes forming an acid solution containing silver and palladium as ions; adding the acid solution while stirring to an aqueous solution containing hydrazine and a surfactant system; and forming reduction-separated silver-palladium fine powders having an average particle diameter less than 1.0 micron. Note also the paragraph bridging columns 1 and 2 of this patent, for the surfactant system used in the described process.

It is respectfully submitted that, as with Kawakita, et al., Jeng-Shyong, et al. discloses a technique for forming conductive particulate wherein, in described uses thereof, the metal powder is used without being sintered. It is respectfully submitted that one of ordinary skill in the art concerned with in Kodera, et al. would not have looked to the teachings of either of Kawakita, et al. or of Jeng-Shyong, et al., having to do with a different technology, and facing different problems, with respect to the ceramic printed circuit substrate of Kodera, et al.

Even assuming, arguendo, that the teachings of Jeng-Shyong, et al. and of Kawakita, et al. were properly combinable with the teachings of Kodera, et al., such combined teachings would have neither disclosed nor would have suggested the presently claimed invention, including the structure formed using the paste having the specific surface area of the silver particles prior to firing, together with the firing being carried out in the specified temperature range, with the structure having been formed using a conductor paste which does not contain any glass, or unexpectedly better results achieved thereby as discussed in the foregoing.

The contention by the Examiner in the first full paragraph on page 3 of the Office Action mailed December 4, 2003, that Kawakita, et al., discloses a conductive paste compound used for printed circuit boards, is respectfully traversed. It is respectfully submitted that Kawakita, et al. discloses a conductive paste compound for via hole filling, as the only disclosed use of the paste in Kawakita, et al., and would have neither disclosed nor would have suggested use of the conductive paste for printed circuit boards generally; and, in particular, would not have disclosed, nor would have suggested, either alone or in combination with the teachings of the other applied

references, a conductive paste used for forming a conductor film on a ceramic board of an electronic component, as in the present claims.

The contention by the Examiner in the last full paragraph on page 3 of the Office Action mailed December 4, 2003, that Jeng-Shyong, et al. discloses that it is well known to those skilled in the art that reduced specific surface area of the silver-palladium fine powders can prevent the occurrence of increased oil absorption, lowered oxidation resistance and other inconveniences, is noted. It is respectfully submitted that this is an overstatement of what is described by Jeng-Shyong, et al. That is, this reference discloses that such reduced specific surface area can prevent occurrence of increased oil absorption, lowered oxidation resistance and other inconveniences "which are results of using silver-palladium powders having a large specific surface area when the silver-palladium powders are used in a circuit screen printing paint or paste" (emphasis added). It is respectfully submitted that in accordance with the technique in Jeng-Shyong, et al., the metal particulate is not sintered. It is respectfully submitted that taking the teachings of Jeng-Shyong, et al. as a whole, as required under 35 USC §103, together with the teachings of the other applied references, this reference discloses a specific use (where reduced specific area of the silver-palladium fine powders can prevent the occurrence of increased oil absorption, lowered oxidation resistance and other inconveniences) which is not relevant to Kodera, et al., such that one of ordinary skill in the art concerned with in Kodera, et al. would not have been motivated from the teachings of Jeng-Shyong, et al. to use silver particles having a specific surface area as in the present claims.

In addition, it is again emphasized that through the specific surface area before the firing of the silver particulate, together with the temperature difference between the

firing and the softening temperature of glass of the ceramic board, and wherein the conductor paste does not contain any glass, unexpectedly better results in solder wettability and bonding strength are achieved according to the present invention, as seen in Figs. 2 and 3 of Applicants original disclosure. In view of these unexpectedly better results, any possible prima facie case of obviousness established by the teachings of the applied prior art is overcome.

In Item 5 on pages 4-6 of the Office Action mailed December 4, 2003, the Examiner sets forth her reasons as to why Applicants' arguments filed September 22, 2003, "have been fully considered but they are not persuasive with regard to [Kodera, et al.]. It is not understood how the Examiner can state that Applicants' arguments filed September 22, 2003, have been fully considered, when the Examiner has provided no comments concerning the evidence of unexpectedly better results relied on by Applicants.

Furthermore, on page 5 of the Office Action mailed December 4, 2003, the Examiner contends that simultaneous firing "is a strong indication" that the conductive paste and substrate meet the ± 50°C difference limitation. It must be emphasized, however, that under the requirements of 35 USC §103 the teachings of the applied references must disclose, or suggest, to one of ordinary skill in the art as of the filing date of the application, the claimed subject matter. It is respectfully submitted that "a strong indication" does not satisfy the statutory requirement for a conclusion of obviousness.

In any event, and again emphasizing the evidence of unexpectedly better results in connection with firing at a temperature having a difference of ± 50°C from a softening temperature of the glass of the ceramic board, it is respectfully submitted that

the evidence of record clearly overcomes any "strong indication" that the conductive paste and substrate meet the ±50°C difference limitation in Kodera, et al. In this regard, it is noted that the Examiner does not even allege that the structure of Kodera, et al. inherently has a firing temperature having a difference of ±50°C from a softening temperature of the glass.

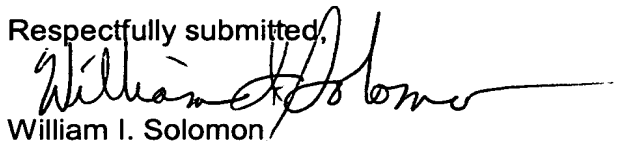
The Examiner contends in the paragraph bridging pages 5 and 6 of the Office Action mailed December 4, 2003, that it is known in the art to use silver particles having small specific surface area; this statement is made without reference to any prior art in connection therewith. Such conclusion without any evidence in support thereof is improper. See In re McKellin, 188 USPQ 428 (CCPA 1976). In any event, it is respectfully submitted that the prior art relied on by the Examiner does not disclose, nor would have suggested, knowledge of using a conductor paste incorporating silver particles having small specific surface area before the firing, in an electronic component including a ceramic board containing glass and a conductor film stuck to the ceramic board, as in the present invention.

The additional contention by the Examiner in the paragraph bridging pages 5 and 6 of the Office Action mailed December 4, 2003, in connection with a prima facie case of obviousness, is noted. Such contention is particularly surprising because the Examiner has ignored evidence of unexpectedly better results in Applicants' original disclosure, which Applicants have repeatedly relied on during prosecution of the above-identified application. To repeat, even if the references establish a prima facie case of obviousness, the evidence of record (that is, the experimental data in Applicants' specification and Figs. 2 and 3) rebuts any such prima facie case of obviousness and establishes unobviousness of the presently claimed subject matter.

In view of the foregoing comments and amendments to the claims, reconsideration and allowance of all claims presently in the application are respectfully requested.

Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, or credit any overpayment of fees, to the deposit account of Antonelli, Terry, Stout & Kraus, LLP, Deposit Account No. 01-2135 (referencing case No. 566.40595X00).

Respectfully submitted,



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